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Holland et al.

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(54) **LUMINAIRE WITH PRISMATIC OPTIC**

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(51) **Int. Cl.**

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F21K 99/00	(2010.01)
F21Y 101/02	(2006.01)

(52) **U.S. Cl.**
CPC . ***F21V 5/02*** (2013.01); *F21K 9/135* (2013.01); *F21Y 2101/02* (2013.01)

(58) **Field of Classification Search**
USPC 362/326–338, 294, 308, 309, 264, 362/217.02–217.17, 240–244, 420, 522, 362/543, 218
See application file for complete search history.

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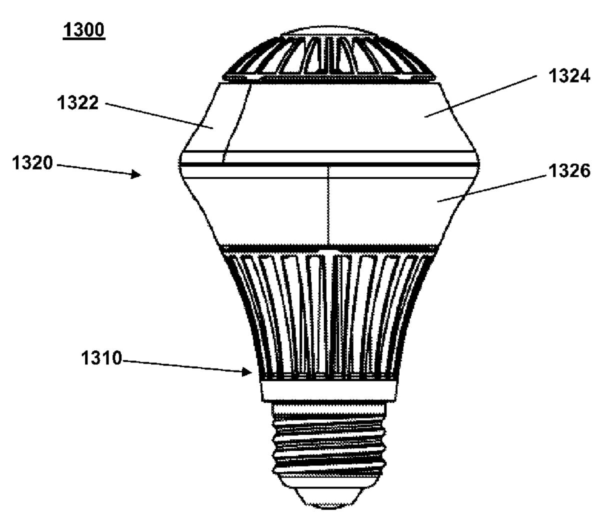
(57) **ABSTRACT**

A luminaire with a prismatic optic permits the nearly uniform distribution of light about the luminaire. The prismatic optic permits the use of directional light sources, such as light emitting diodes, while maintaining the uniform light distribution. Furthermore, a concave shape of the optic further enables uniform light distribution. When light emitting diodes are used, the luminaire further includes a heat sink to maintain a desirable operational temperature without negatively affecting the light distribution properties of the luminaire.

12 Claims, 9 Drawing Sheets



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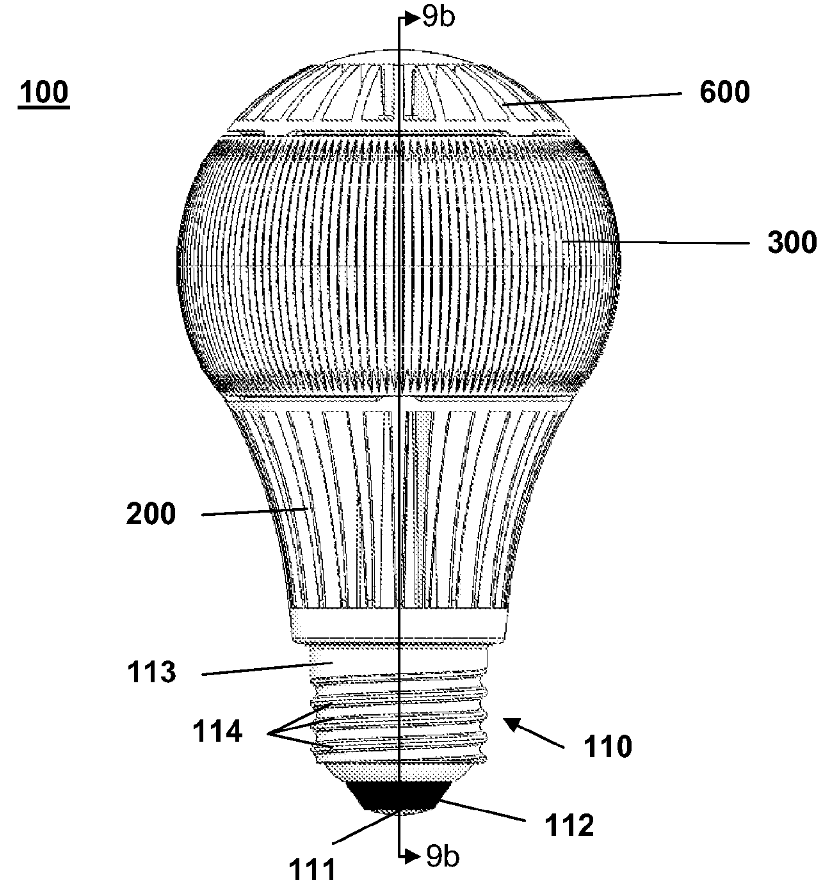
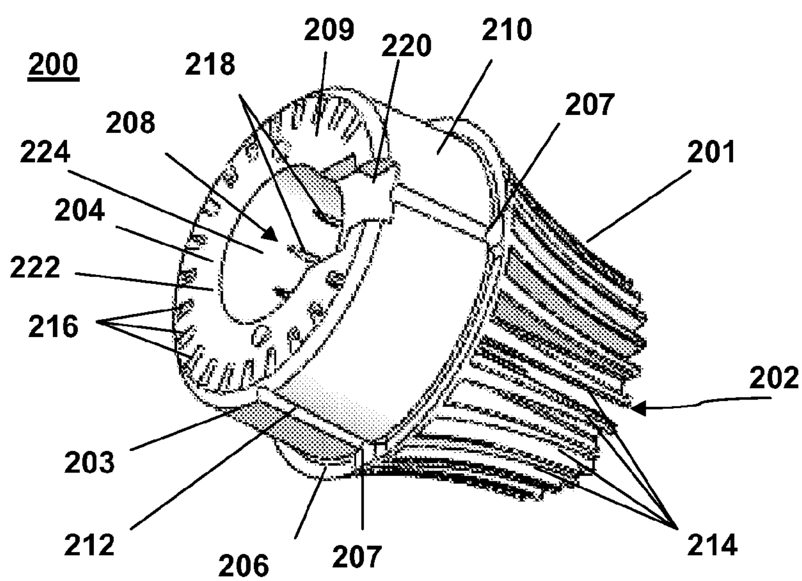


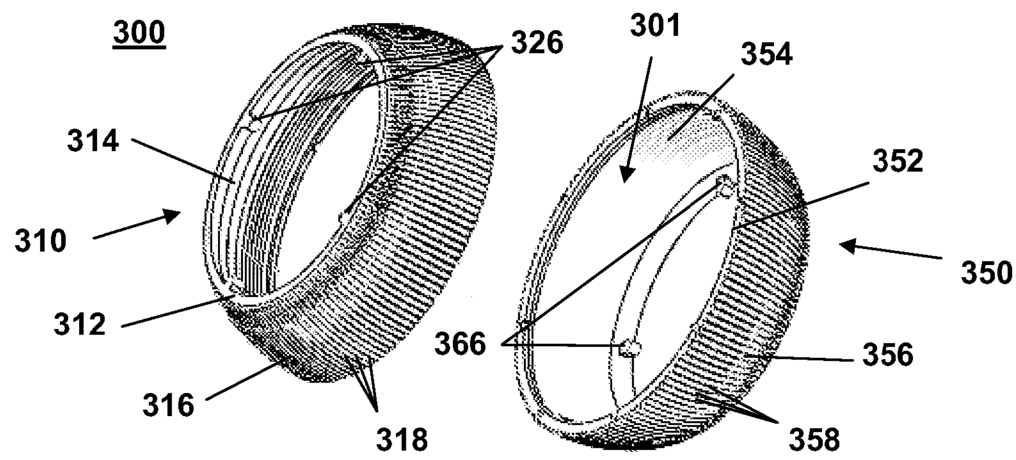
100
9b
600
300
200
113
114
110
112
111
9b

FIG. 1



200
209
220
210
218
208
207
224
201
204
222
216
202
203
212
206
207
214

FIG. 2


300
326
301
354
314
352
310
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312
366
356
316
318
358

FIG. 3

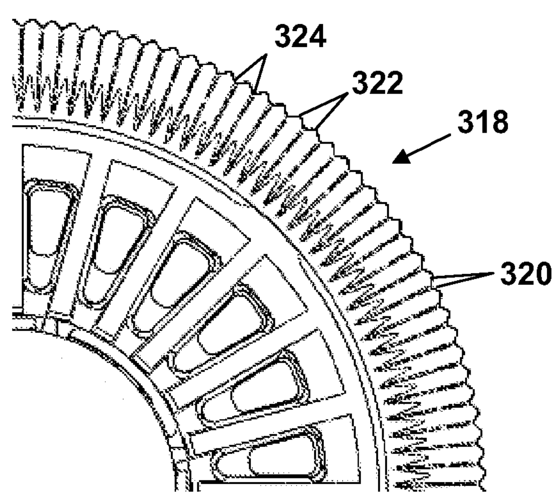

324
322
318
320

FIG. 4a

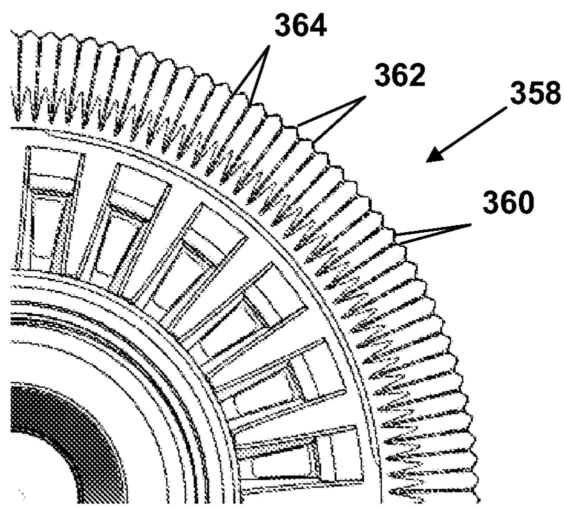


FIG. 4b

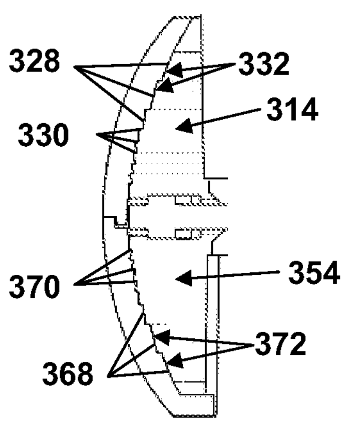
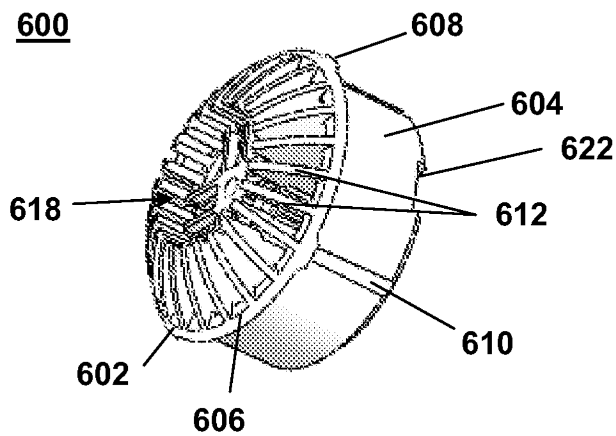


FIG. 5


600
608
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622
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612
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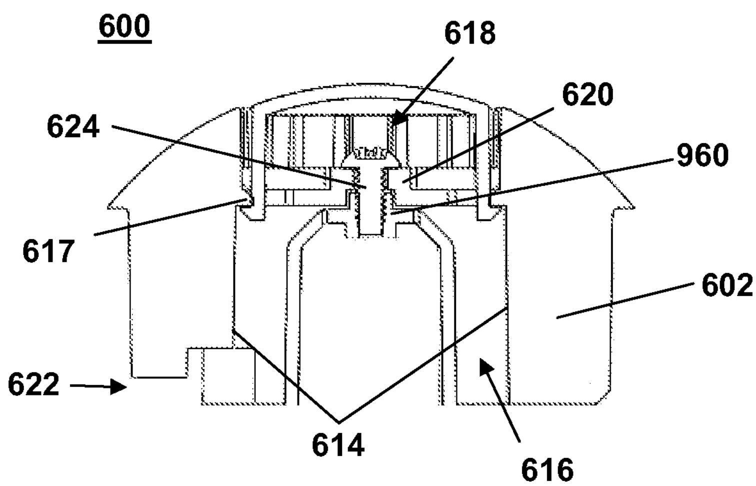
602
606

FIG. 6


600
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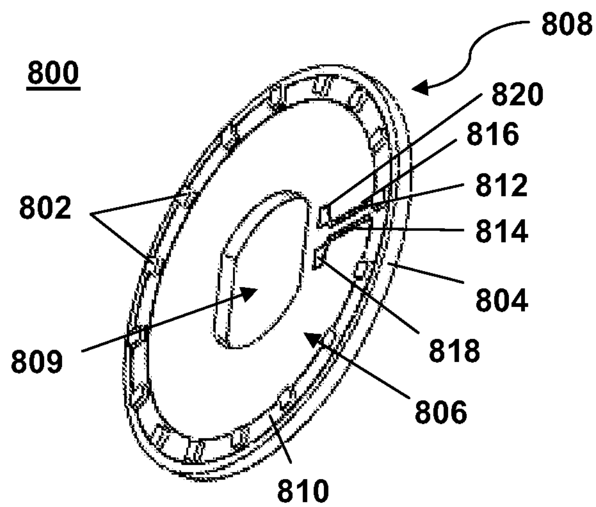
616

FIG. 7


800
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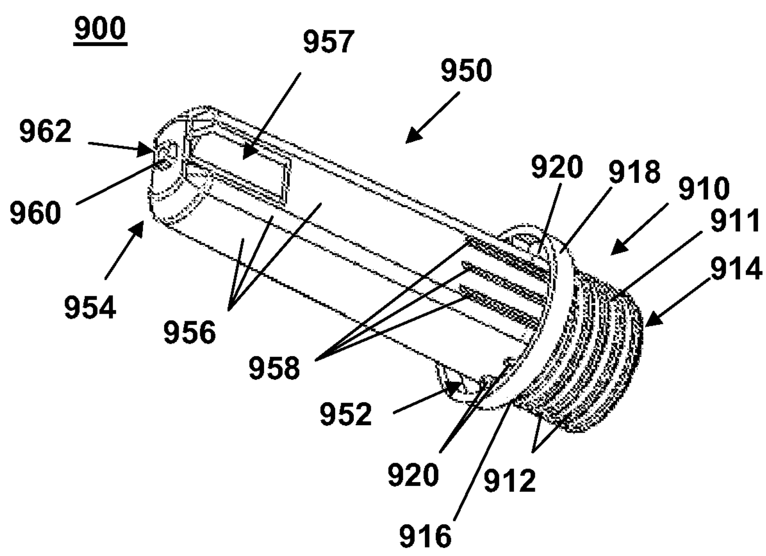
809
802

FIG. 8


900
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912
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FIG. 9a

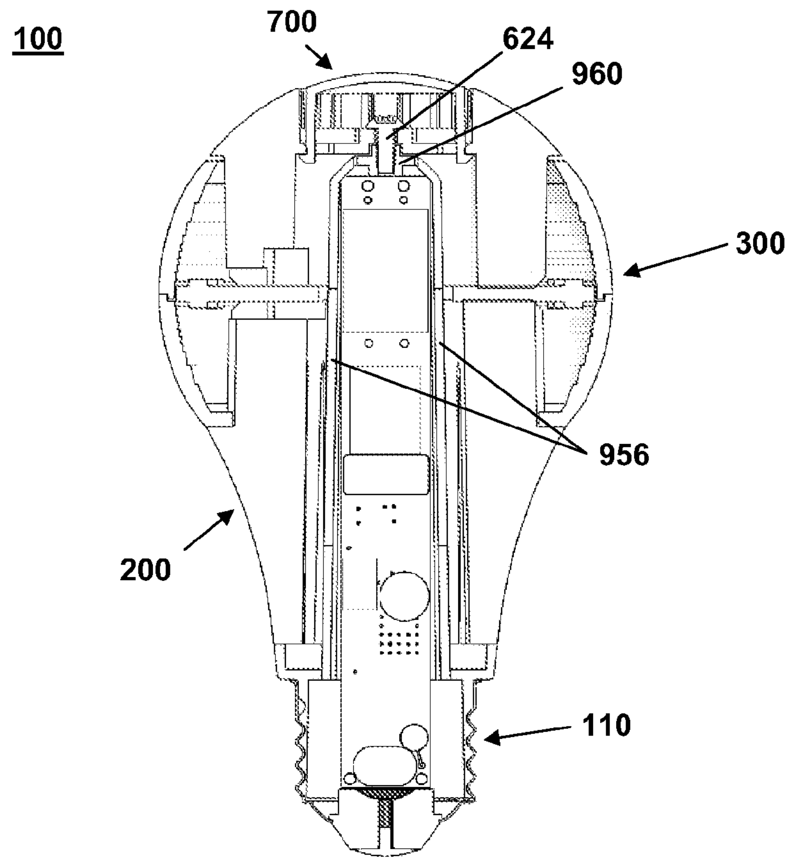

FIG. 9b

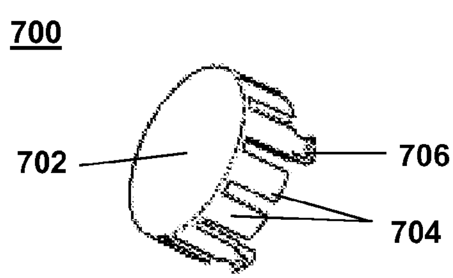

FIG. 10

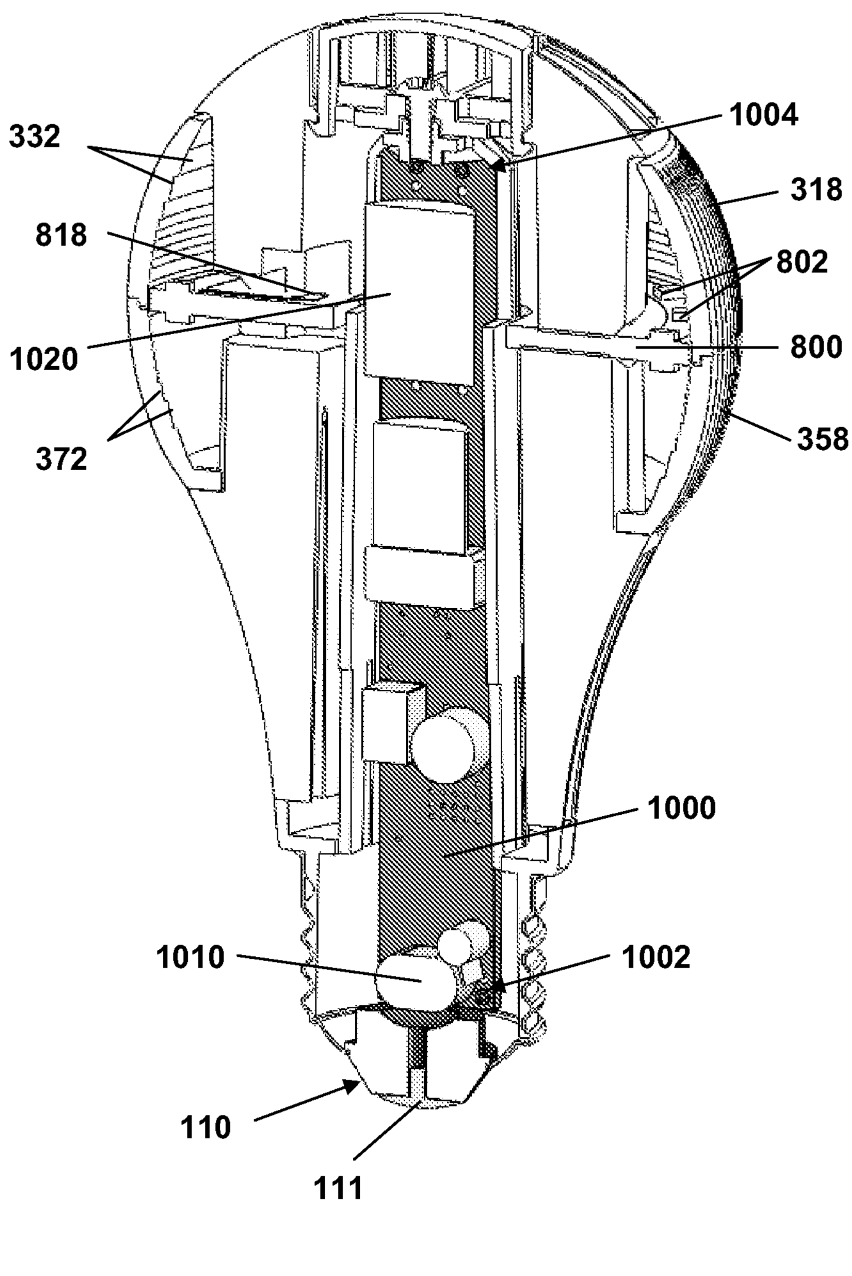

FIG. 11

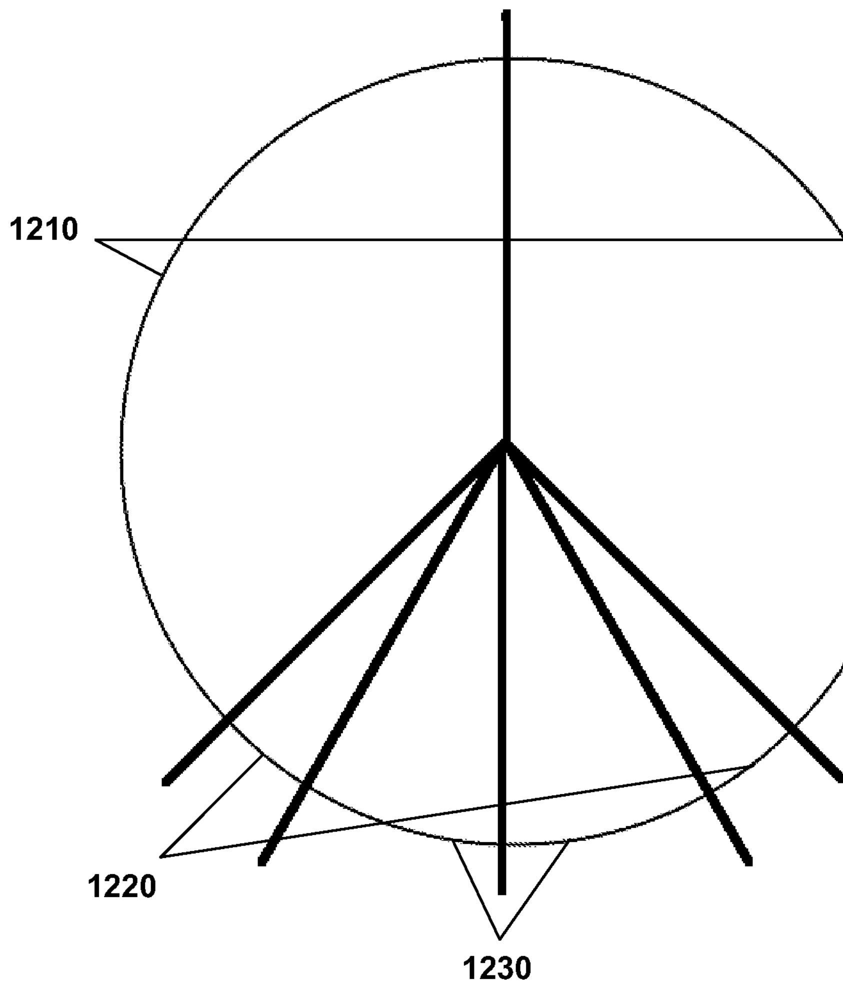

FIG. 12

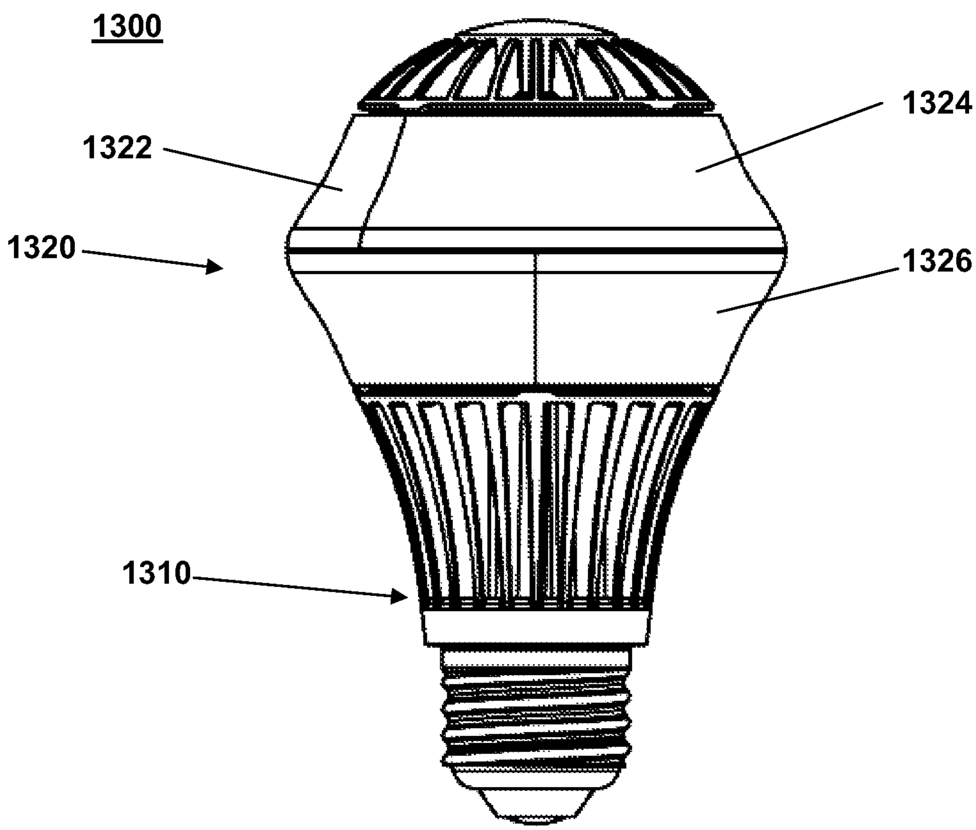

FIG. 13

LUMINAIRE WITH PRISMATIC OPTIC

RELATED APPLICATIONS

This application is a continuation-in-part and claims the benefit under 35 U.S.C. §120 of U.S. patent application Ser. No. 13/739,054 titled Luminaire with Prismatic Optic filed Jan. 11, 2013, which in turn is related to and claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Patent Application Ser. No. 61/642,205 titled Luminaire with Prismatic Optic filed May 3, 2012, the contents of which are incorporated in their entirety herein.

FIELD OF THE INVENTION

The present invention relates to systems and methods for generating light, and more particularly, a system for effectively distributing light substantially about a light bulb.

BACKGROUND OF THE INVENTION

Achieving nearly uniform light distribution about a light bulb has long been a goal in the lighting industry. Success in this goal has largely depended upon the method of providing light employed by the bulb. Specifically, different methods of light generation produce light with different distributions, which must be compensated for in the construction of the bulb.

Most of the earliest light bulbs were incandescent, which generate light by heating a filament wire until it glows. Due to the relatively sparse nature of the supporting structures necessary for the filament, and due to the 360-degree dispersion of light by the filament, achieving nearly uniform distribution about an incandescent light bulb was not difficult to achieve. However, due to inefficiencies in the method of light production employed in incandescent light bulbs, other methods are desirable.

Fluorescent lamps, specifically compact fluorescent lamps (CFLs), have been steadily replacing incandescent light bulbs in many lighting applications. Similar to incandescent, CFLs produce light in approximately 360 degrees by exciting mercury vapor to cause a gas discharge of light. CFLs are more energy efficient than incandescent light bulbs, but suffer a number of undesirable traits. Many CFLs have poor color temperature, resulting in a less aesthetically pleasing light. Some CFLs have prolonged warm-up times, requiring up to three minutes before maximum light output is achieved. All CFLs contain mercury, a toxic substance that must be handled carefully and disposed of in a particular manner. Furthermore, CFLs suffer from a reduced life span when turned on and off for short period. Therefore, there are a number of disadvantages to using CFLs in a lighting system.

Light emitting diodes (LEDs) are increasingly being used as the light source in light bulbs. LEDs offer greater efficiencies than CFLs, have an increased life span, and are increasingly being designed to have desirable color temperatures. Moreover, LEDs do not contain mercury or any other toxic substance. However, by the very nature of their design and operation, LEDs have a directional output. Accordingly, the light emitted by an LED may not have the nearly omni-directional and uniform light distribution of incandescents and CFLs. Although multiple LEDs can and frequently are used in a single light bulb, solutions presented so far do not have light distribution properties approximating or equaling the dispersion properties of incandescents or CFLs. Accordingly, there is a long felt need for a light bulb that can utilize

LEDs as a light source while maintaining uniform and nearly omni-directional light distribution properties.

One issue facing the use of LEDs to replace traditional light bulbs is heat. LEDs suffer damage and decreased performance when operating in high-heat environments. Moreover, when operating in a confined environment, the heat generated by the LED and its attending circuitry itself can cause damage to the LED. Heat sinks are well known in the art and have been effectively used to provide cooling capacity, maintaining an LED-based light bulb within a desirable operating temperature. However, heat sinks can sometimes negatively impact the light distribution properties of the light bulb, resulting in non-uniform distribution of light about the bulb. Accordingly, there is a long felt need for an LED-based light bulb capable of providing uniform light distribution that maintains a desirable operating temperature.

This background information is provided to reveal information believed by the applicant to be of possible relevance to the present invention. No admission is necessarily intended, nor should be construed, that any of the preceding information constitutes prior art against the present invention.

SUMMARY OF THE INVENTION

With the foregoing in mind, embodiments of the present invention are related to a luminaire that utilizes a prismatic optic to distribute light from a light emitting element within the luminaire approximately uniformly about the luminaire. The luminaire, according to embodiments of the present invention, can also advantageously combine this prismatic optic with one or more light emitting diodes (LEDs) as a light source, overcoming previous deficiencies in LED-based luminaire designs.

These and other objects, features, and advantages according to the presenting invention are provided by a luminaire including a light source and a prismatic optic. The light source may include one or more LEDs that emit light that is incident upon the prismatic optic. The prismatic optic, in turn, may refract the light substantially about the luminaire, resulting in approximately omni-directional and uniform light distribution. The luminaire may further include a base for connection to a light socket and a heat sink for cooling the light source. The base may be attached to the heat sink, which is, in turn, attached to the light source and the prismatic optic. A surface of the heat sink may have reflective properties configured to reflect light generally towards the prismatic optic. The luminaire may further include a circuit board including circuitry configured to power the light source. The circuit board may be positioned so as to be optimally cooled by the heat sink.

The prismatic optic, according to embodiments of the present invention, may be configured to have specific light refracting properties. Specifically, the prismatic optic may refract light within certain regions with certain uniformities. The light may be refracted within regions of 0 degrees to 135 degrees, 135 degrees to 150 degrees, and 150 degrees to 180 degrees. Furthermore, the light may be of uniform intensity to within a certain percentage of an average intensity, such as within 20%, within 10%, within 5%, or within 1%.

The light source may include a platform upon which one or more LEDs may be attached. The LEDs may be attached to an upper surface and/or a lower surface of the platform, increasing light distribution. Furthermore, the platform may include a section within which the LEDs may be attached that facilitates electric coupling between the LEDs and the circuit board.

A method aspect of the present invention is for using the luminaire. The method may include the steps of generating light and refracting light according to a desired light distribution.

In some embodiments, the optic may have a first and second surfaces. The first surface may comprise a plurality of generally vertical and horizontal segments. Furthermore, the second surface may comprise a curvature. In some embodiments, the curvature may be generally concave.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a luminaire according to an embodiment of the present invention.

FIG. **2** is a perspective view of a lower structure of the luminaire presented in FIG. **1**.

FIG. **3** is a perspective view of a prismatic optic of the luminaire presented in FIG. **1**.

FIG. **4***a* is a partial top view of the luminaire presented in FIG. **1**.

FIG. **4***b* is a partial bottom view of the luminaire presented in FIG. **1**.

FIG. **5** is a partial side sectional view of the prismatic optic of the luminaire presented in FIG. **1**.

FIG. **6** is a perspective view of an upper structure of the luminaire presented in FIG. **1**.

FIG. **7** is a partial side sectional view of the upper section presented in FIG. **6**.

FIG. **8** is a perspective view of a light source used in connection with the luminaire presented in FIG. **1**.

FIG. **9***a* is a perspective view of a housing used in connection with the luminaire presented in FIG. **1**

FIG. **9***b* is a side sectional view of the luminaire presented in FIG. **1** taken through line **9***b*-**9***b*.

FIG. **10** is a perspective view of a cap used in connection with the luminaire presented in FIG. **1**.

FIG. **11** is a perspective view of the cross section view of the luminaire as presented in FIG. **9***b*.

FIG. **12** is a polar graphical illustration representing a light distribution of the luminaire presented in FIG. **1**.

FIG. **13** is a side elevation of a luminaire according to an alternative embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Those of ordinary skill in the art realize that the following descriptions of the embodiments of the present invention are illustrative and are not intended to be limiting in any way. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure. Like numbers refer to like elements throughout.

Although the following detailed description contains many specifics for the purposes of illustration, anyone of ordinary skill in the art will appreciate that many variations and alterations to the following details are within the scope of the invention. Accordingly, the following embodiments of the invention are set forth without any loss of generality to, and without imposing limitations upon, the claimed invention.

In this detailed description of the present invention, a person skilled in the art should note that directional terms, such as "above," "below," "upper," "lower," and other like terms are used for the convenience of the reader in reference to the drawings. Also, a person skilled in the art should notice this description may contain other terminology to convey position, orientation, and direction without departing from the principles of the present invention.

An embodiment of the invention, as shown and described by the various figures and accompanying text, provides a luminaire **100**. Referring initially to FIG. **1**, a luminaire **100** according to an embodiment of the present invention is depicted, the luminaire **100** including a base **110**, a lower structure **200**, a prismatic optic **300**, and an upper structure **600**.

The base **110** of the present embodiment of the luminaire **100** is configured to conform to an Edison screw fitting that is well known in the art. However, the base **110** may be configured to conform with any fitting for light bulbs known in the art, including, but not limited to, bayonet, bi-post, bi-pin, and wedge fittings. Additionally, the base **110** may be configured to conform to the various sizes and configurations of the aforementioned fittings.

In the present embodiment, the base **110** of the luminaire **100** may include an electrical contact **111** formed of an electrically conductive material, an insulator **112**, and a sidewall **113** comprising a plurality of threads **114**. The plurality of threads **114** may form a threaded fitting on inside and outside surfaces of the sidewall **113**. The electrical contact **111** may be configured to conduct electricity from a light socket.

Turning to FIG. **2**, the lower structure **200** may have a lower section **201** defining a first end **202** and an upper section **203** defining a second end **204**. The interface between the lower section **201** and the upper section **202** may define a shelf **206** disposed about a perimeter the lower section **201**. The shelf **206** may include one or more attachment sections **207** at which the prismatic optic **300** may attach to the lower structure **200**. The first end **202** may be attached to the base **110** at the sidewall **113** by any means known in the art, including, not by limitation, use of adhesives or glues, welding, and fasteners.

Each of the first section **201** and the second section **203** may include a void that cooperates with each other to define a longitudinal cavity **208**. The shape and dimensions of the longitudinal cavity **208** will be discussed in greater detail hereinbelow. The upper section **203** may include a body member **209** having an outside surface **210**. The outer surface **210** may be positioned along a longitudinal axis of the luminaire **100**. The outer surface **210** may be configured to reflect light incident thereupon. The outer surface **210** may have a reflection coefficient of at least about 0.1, or about 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, or 0.9, or about 0.91, 0.92, 0.93, 0.94, 0.95, 0.96, 0.97, 0.98, or 0.99, or about 1. In one embodiment, the outer surface **210** may act as a substrate and have a layer of reflective paint applied thereto. The reflective paint may advantageously enhance illumination provided by the light source by causing enhanced reflection of the light prior to reaching the prismatic enclosure **300**, which will be discussed in greater detail below. In another embodiment, the outer surface **210** may have a reflective liner applied thereto. Similarly, the reflective liner may be readily provided by any type of reflective liner which may be known in the art.

The upper section **203** may further include one or more channels **212** formed in the outer surface **210**. The channels **212** may be configured to align with the attachment sections

207 and run parallel to the longitudinal cavity **208**, facilitating the attachment of the prismatic optic **300** to the lower structure **200**.

In the present embodiment, the lower structure **200** may be configured to act as a heat sink. Accordingly, portions of the lower structure **200** may be formed of thermally conductive material. Moreover, portions of the lower structure **200** may include fins **214**. In this embodiment, the fins **214** are configured to run the length of the lower section **201** and extend radially outward therefrom. The fins **214** increase the surface area of the lower structure **200** and permit fluid flow between each fin **214**, enhancing the cooling capability of the lower structure **200**. The fins **214** may have a curved vertical profile to emulate the shape of traditional incandescent light bulbs. Optionally, the fins **214** may be configured to conform to the A19 light bulb standard size. Additional information directed to the use of heat sinks for dissipating heat in an illumination apparatus is found in U.S. Pat. No. 7,922,356 titled Illumination Apparatus for Conducting and Dissipating Heat from a Light Source, and U.S. Pat. No. 7,824,075 titled *Method and Apparatus for Cooling a Light Bulb*, the entire contents of each of which are incorporated herein by reference.

Furthermore, the lower structure **200** may include interior channels formed in the body member **209**. The interior channels may extend from a first opening **216** in an upper surface **222** of the body member **209** to a second opening **218** in an interior surface **224** of the upper section **203** forming the longitudinal cavity **208**. Air may be permitted to flow through the interior channels, providing additional cooling capability. Alternatively, the lower structure **200** may be formed as a substantially solid structure, not including the various structural aspects intended to increase the cooling capacity as described above. The lower structure **200** may further include a recessed region **220** formed in the upper surface **222** of the body member **209**. The recessed region may extend from the void of the upper section **203** to the outside surface **210**.

Referring now to FIG. **3**, a prismatic optic **300** according to an embodiment of the present invention is depicted. In the present embodiment, the prismatic optic **300** may include an upper optic **310** and a lower optic **350**. The upper optic **310** may be attached to the lower optic **350** by any method known in the art, including, but not limited to, threaded coupling, interference fit, adhesives, glues, fasteners, and welding, or combinations thereof. Moreover, in an alternative embodiment, the upper optic **310** and the lower optic **350** may be integrally formed as a single optic. The prismatic optic **300** is configured to define an optical chamber **301**, wherein the optical chamber **301** is configured to permit a light source to be disposed therein.

The prismatic optic **300** may be formed of any transparent, translucent, or substantially translucent material including, but not limited to, glass, fluorite, and polymers, such as polycarbonate. Types of glass include, without limitation, fused quartz, soda-lime glass, lead glass, flint glass, fluoride glass, aluminosilicates, phosphate glass, borate glass, and chalcogenide glass.

Each of the upper optic **310** and the lower optic **350** may include a sidewall **312**, **352** comprising an inner surface **314**, **354** and an outer surface **316**, **356**. Each of the outer surfaces **316**, **356** may comprise a plurality of grooves **318**, **358** formed thereon. Turning to FIGS. **4***a*-*b*, the grooves **318**, **358** are configured to have substantially straight sides **320**, **360**, the sides forming alternating peaks **322**, **362** and valleys **324**, **364**. The angles formed at the peaks **322**, **362** and valleys **324**, **364**, as well as the length of the sides **320**, **360** may be selectively chosen to alter the refraction of light thereby.

Returning now back to FIG. **3**, each of the outside surfaces **316**, **356** may be configured to have a curvature. The degree of the curvature may be selected according to design standards, such as, a curvature that conforms to an A19 light bulb standard, having a diameter of about 2.375 inches. The curvature may also conform to any other industry standard, including, but not limited to, A15 (about 1.875 inches), A21 (about 2.625 inches), G10 (about 1.25 inches), G20 (about 2.5 inches), G25 (about 3.125 inches), G30 (about 3.75 inches), and G40 (about 5 inches). The preceding are provided for exemplary purposes and are not limiting in any way.

The lower optic **350** may include one or more protruding members **366** extending radially inward from a first end the inner surface **354**. The protruding members **366** may be configured to pass through the one or more channels **212** to interface with the attachment sections **207**, which are depicted in FIG. **2**. Each protruding member **366** may be associated with one channel **212** and one attachment section **207**. Each of the protruding members **366** may be attached to an attachment section **207**, thereby attaching the optic **300** to the lower structure **200**. The protruding members **366** may be attached to the attachment sections **207** by any method that can withstand the forces experienced by the luminaire **100**, such as those experienced during installation and removal. Methods of attachment include, but are not limited to, adhesives, glues, welding, and fasteners. Similarly, the upper optic **310** may include protruding members **326** extending radially inward from a first end of the inner surface **314**. The protruding members **326** may be configured to attach to the upper structure **600** described in detail hereinbelow.

Referring now to FIG. **5**, each of the inner surfaces **314**, **354** may include a plurality of generally vertical segments **328**, **368** and a plurality of generally horizontal segments **330**, **370**. Each of the generally vertical segment **328**, **368** may have two ends and may be attached at each end to a generally horizontal segment **330**, **370**, thereby forming a plurality of prismatic surfaces **332**, **372**. It is not a requirement of the invention that the generally vertical segments **328**, **368** be perfectly vertical, nor is it a requirement that the generally horizontal segments **330**, **370** be perfectly horizontal. Similarly, it is not a requirement of the invention that the generally vertical segments **328**, **368** be perpendicular to the generally horizontal segments **330**, **370**. Each of the prismatic surfaces **332**, **372** may be smooth, having a generally low surface tolerance. Moreover, each of the prismatic surfaces **332**, **372** may be curved, forming a diameter of the inner surfaces **314**, **354**.

The variance of the generally vertical segments **328**, **368** from vertical may be controlled and configured to desirously refract light. Similarly, the variance of the generally horizontal segments **330**, **370** from horizontal may be controlled and configured to produce prismatic surfaces **330**, **370** that desirously refract light. Accordingly, the prismatic surfaces **332**, **372** may cooperate with the grooves **318**, **358**, as depicted in FIGS. **3** and **4***a*-*b*, to desirously refract light about the luminaire **100** (shown in FIG. **1**).

Referring now to FIG. **6**, the upper structure **600** of an embodiment of the present invention is depicted. The upper structure **600** may include a body member **602** having an outer surface **604**. The outer surface **604** may be configured to reflect light incident thereupon. The outer surface **604** may have a reflection coefficient of at least about 0.1, or about 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, or 0.9, or about 0.91, 0.92, 0.93, 0.94, 0.95, 0.96, 0.97, 0.98, or 0.99, or about 1. In one embodiment, the outer surface **604** may act as a substrate and may have a layer of reflective paint applied thereto. In another embodiment, the outer surface **604** may have a reflective liner applied thereto.

The upper structure **600** may further include a ridge **606**. The ridge **606** may interface with the prismatic optic **300**, thereby constraining the prismatic optic **300** between the upper structure **600** and the lower structure **200**. Furthermore, the ridge **606** may include one or more attachment surfaces **608** configured to facilitate attachment of the upper structure **600** to the prismatic optic **300**, as shown in FIG. **3**. The protruding members **326** of the upper optic **310** may be attached to the attachment sections **608** by any method that can withstand the forces experienced by the luminaire **100**, such as those experienced during installation and removal. Methods of attachment include, but are not limited to, adhesives, glues, welding, and fasteners.

The upper structure **600** may further include one or more channels **610** formed in the outer surface **604**. The channels **610** may be configured to align with the attachment sections **608**, permitting the passage of protruding members **326** therethrough and facilitating the attachment of the prismatic optic **300** to the upper structure **600**.

In the present embodiment, the upper structure **600** may be configured to act as a heat sink. Accordingly, portions of the upper structure **600** may be formed of thermally conductive material. Moreover, portions of the upper structure **600** may include fins **612**. In the illustrated embodiment, the fins **612** are configured to extend from the ridge **606** generally upwards and towards a longitudinal axis of the upper structure **600**. The fins **612** advantageously increase the surface area of the upper structure **600** and permit fluid flow between each fin **612**, enhancing the cooling capability of the lower structure **600**. The fins **612** may have a curved vertical profile to emulate the shape of traditional incandescent light bulbs. Optionally, the fins **612** may be configured to conform to the A19 light bulb standard size. Those skilled in the art will appreciate that the present invention contemplates the use of various configurations of fins to enhance heat dissipation.

Referring now additionally to FIG. **7**, the body member **604** may further include an inner surface **614** defining an internal cavity **616**. The internal cavity **616** may be configured to cooperate with the longitudinal cavity **208** of the lower structure **200**, defining a continuous cavity. Furthermore, the body member **602** may include a shelf **617** extending radially inward from the inner surface **614** into the internal cavity **616**.

As also illustrated in FIGS. **6-7**, the upper structure **600** may further include a recessed section **618** on the top of the upper structure **600**. The recessed section **618** may include an upper attachment section **620**. The upper attachment section **620** may be configured to attach a housing **900** (described below and illustrated in FIG. **9**) thereto. The circuit board will be described in greater detail hereinbelow. The attachment section **620** may be configured to permit attachment by any method known in the art, including, but not limited to, fasteners, such as screw and threads, adhesives, glues, and welding. The upper structure **600** may further include a recessed region **622** formed in a lower surface of the body member **604**. The recessed region **622** may be positioned so as to approximately align with the recessed region **220** of the lower structure **200**. Alternatively, the upper structure **600** may be formed as a substantially solid structure, not including the various structural aspects intended to increase the cooling capacity as described above.

Referring now to FIG. **8**, according to an embodiment of the invention, a luminaire including a light source **800** is provided. The present embodiment of the light source **800** employs one or more light emitting elements **802**. The light emitting elements **802** may be disposed within the optical chamber **301** of the prismatic optic **300**, as depicted in FIG. **3**.

The light emitting elements **802** may be oriented to emit light that is incident upon the prismatic surfaces **332** of the upper optic **310** as well as the prismatic surfaces **372** of the lower optic **350**, as depicted, for example, in FIG. **5**. Accordingly, the light emitting elements **802** may be configured to emit light generally radially outward as well as upwards and downwards from the luminaire **100**, as shown in FIG. **1**.

According to the present embodiment of the invention, the light source **800** may include a platform **804**. The platform **804** may include an upper surface **806**, a lower surface **808**, and a void **809**, wherein each of the upper and lower surfaces **806**, **808** are generally flat and configured to permit attachment of the light emitting elements **802** thereto. For example, the light source **800** may include a channel **810** formed into one of the upper surface **806** and the lower surface **808**, or both. The channel **810** may be configured to form a region in the upper surface **806** into which the light emitting elements **802** may be there attached.

The location of the channel **810** on the upper surface **806** may be selectively chosen. In the present embodiment, the channel **810** is formed generally about the periphery of the upper surface **806**, although the channel **810** may be formed in any part of the upper surface **806**. In some embodiments, a plurality of light emitting elements **802** may be distributed within the channel **810**. Each of the plurality of light emitting elements **802** may be selectively distributed, for example, they may be spaced at regular intervals. In an alternative example, the light emitting elements **802** may be clustered in groups. The configuration of the disposition of the light emitting elements **802** may be selected to achieve a desired lighting profile or outcome.

The channel **810** may further include an attachment material disposed within the channel **810**. The attachment material may facilitate the attachment of the light emitting elements **802** within the channel **810**. Furthermore, the attachment material may facilitate the operation of the light emitting elements **802**. For example, where the light emitting elements **802** are LEDs, the attachment material may be formed of an electrically conductive material. Furthermore, the attachment material may be configured to include two or more electrical conduits that are isolated from each other, facilitating the operation of the light emitting elements **802**.

The light source **800** may further comprise a communication section **812** formed adjacent the channel **810**. Accordingly, the communication section **812** may be formed in either of the upper surface **806** and the lower surface **808**, or both. The communication section **812** may contact the channel **810**. Furthermore, the communication section **812** may be formed of an electrically conductive material. Accordingly, the communication section **812** may be in electrically coupled to the channel **810**.

The communication section **812** may include a first terminal **814** and a second terminal **816**. Each of the first and second terminals **814**, **816** may be formed of an electrically conductive material, may contact the channel **810**, and further may be electrically coupled to the channel **810**. Furthermore, where the channel **810** may include an attachment section including two or more isolated electrical conduits, the first terminal **814** may be in communication with a first electrical conduit of the attachment section, and the second terminal **816** may be in communication with a second electrical conduit of the attachment section. For example, and not by limitation, the first terminal **814** may be in communication with a power source conduit, and the second terminal may be in communication with a ground conduit.

Still referring to FIG. **8**, the first and second terminals **814**, **816** may each include a pad **818**, **820** respectively. The pads **818**, **820** may be configured to facilitate attachment of an electrical communication medium thereto. For example, and not by limitation, the dimensions of the pads may be selectively chosen to permit a wire to be soldered thereto. The pads **818**, **820** may be disposed approximately adjacent to the void **809**. Moreover, the pads **818**, **820** may be positioned so as to approximately align with the recessed region **220** of the lower structure **200** and the recessed region **622** of the upper structure **600**. The void **809** may be disposed about approximately the center of the platform **804**. The void **809** may be positioned and dimensioned to approximately align with the longitudinal cavity **208** as shown in FIG. **1** and the internal cavity **616** as shown in FIG. **7**, defining a continuous cavity.

Referring now to FIG. **9***a*, a housing **900** according to an embodiment of the invention is presented. The housing **900** may be configured to be disposed substantially about a power source. The housing **900** may include a base section **910** and a monolithic section **950**. The base section **910** may be configured to attach the housing **900** to the base **110** as shown in FIG. **1**. Specifically, the base section **910** may include a body member **911** including plurality of threads **912** configured to cooperate with the threads **114** of the base **110**, wherein the threads **114** are functional on both an inside surface and an outside surface of the base **110**. Alternatively, the base section **910** may be attached to the base **110** by other methods, including, but not limited to, adhesives, glues, fasteners, and welding.

The base section **910** may include an opening (not shown) at a first end **914**. The opening may be configured to have the shape and sufficient dimensions to permit a power source to pass therethrough. The base section **910** may further include a flange **916** extending radially outward from the body member **911**. The base section **910** may still further include a sidewall **918** extending approximately orthogonally from the flange **916**. In one embodiment, the sidewall **918** may be configured to interfere with the fins **214** of the lower structure **200**. In such an embodiment, the housing **900** may be disposed within the longitudinal cavity **208** of the lower structure **200**, and the interference between the sidewall **918** and the fins **214** restricts the translation of the housing **900** beyond the point of that interference. Further, the base section **910** may include one or more ribs **920** that may be attached to the sidewall **918**, the flange **916**, and the monolithic section **950**.

The monolithic section **950** may be configured as a hollow, generally straight, substantially elongated structure. It may include a first end **952** and a second end **954**, with the first end **952** being adjacent the base section **910** and the second end **954** being substantially apart from the base section **910**. The monolithic section **950** may include one or more sidewalls **956** intermediate the first end **952** and the second end **954**, extending generally upward from the base section **910**. The sidewalls **956** may be attached and continuous, so as to define an internal cavity there between. The dimensions of the internal cavity may be sufficient to permit a power source to be at least partially disposed therein, as depicted in FIG. **9***b*.

At least one of the sidewalls **956** may include an opening **957** towards the second end **954**. The opening **957** may be configured to facilitate the electrical coupling between a power source and the light source, illustrated in FIG. **8**, and described in greater detail hereinbelow.

At least one of the sidewalls **956** may include one or more vents **958**. The vents **958** may be positioned anywhere along the sidewall **956**. In the present embodiment, the vents **958** are positioned substantially toward the first end **952**. The positioning of the vents **958**, as well as their shape and dimensions, may be selected so as to facilitate the flow of air between the internal cavity defined by the sidewalls **956** and the area surrounding the housing **900**. In one embodiment of the invention, the flow of air may increase the cooling capability of the housing **900**, thereby reducing the operating temperature of a power source disposed within the internal cavity defined by the sidewalls **956**. For example, the vents **958** may be positioned adjacent those parts of a power source that generate the most heat, permitting the rapid transportation of air heated by the power source out of the housing **900** and to heat sinks, such as certain embodiments of the upper structure **200** and the lower structure **600**.

The monolithic section **950** may further include an attachment section **960** located substantially towards the second end **954**. Referring now to FIG. **7**, the attachment section **960** may be configured to attach to the upper attachment section **620** of the upper structure **600**. The attachment section includes a receiving lumen **962** through which a fastener may be disposed and attached thereto. In the present embodiment, a fastener **624** is disposed through the upper receiving section **620** and into the receiving lumen **962**, attaching to the receiving lumen, thereby fixedly attaching the housing **900** to the upper structure **600**. However, alternative embodiments permit the attachment section **960** to attach to the upper attachment section **920** by any method known in the art, including, but not limited to, adhesives, glues, and welding.

Referring now to FIG. **10**, according to an embodiment of the invention, a luminaire including a cap **700** is provided. The cap **700** is configured to cover the recessed section **618** of the upper structure **600**, as depicted in FIG. **7**. The cap **700** includes a domed section **702** and a plurality of tabs **704** extending generally downward and approximately perpendicular to the domed section **702**. One or more of the plurality of tabs **704** may include a catch **706** disposed on one end of the tab **704**. As shown in FIG. **7**, the catch **706** may engage with the shelf **617** of the upper structure **600**, thereby removably coupling the cap **700** to the upper structure **600**.

Referring now to FIG. **11**, a power source according to an embodiment of the present invention is presented. In the present embodiment, the power source may include a circuit board **1000**. The circuit board **1000** may be configured to condition power to be used by the light emitting elements **802** of the light source **800**. Furthermore, the circuit board **1000** may have a first end **1002** and a second end **1004**, wherein the first end **1002** is positioned generally downward and toward the base **110**, and the second end **1004** is positioned generally upward and toward the upper structure **600**. The circuit board **1000** may be dimensioned to permit at least a portion of the circuit board **1000** to be disposed within the internal void of the housing **900**.

The circuit board **1000** may include a first electrical contact **1010**. The first electrical contact may be positioned toward the first end **1002** of the circuit board **1000**. The first electrical contact **1010** may be configured to electrically couple with the electrical contact **111** of the base **110**, thereby enabling the first electrical contact **1010** to supply power to the circuit board **1000**. The circuit board **1000** may further include a second electrical contact **1020**. The second electrical contact **1020** may be positioned toward the second end **1004** of the circuit board **1000**. The second electrical contact **1020** may be configured to electrically couple with the pads **818**, **820** (**820** not shown) of the light source **800**. The electrical coupling between the second electrical contact **1020** and the pads **818**, **820** enables the circuit board **1000** to deliver power to the light emitting elements **802**.

In one embodiment, the electrical contact **111** conducts power from a light fixture that provides 120-volt alternating current (AC) power. Furthermore, in the embodiment, the light emitting elements **802** comprise LEDs requiring direct current (DC) power at, for instance, five volts. Accordingly, the circuit board **1000** may include circuitry for conditioning the 120-volt AC power to 5-volt DC power.

In a further embodiment, the circuit board **1000** may include a microcontroller. The microcontroller may be programmed to control the delivery of electricity to the light source. The microcontroller may be programmed to, for instance, dim the light emitting elements **802** according to characteristics of the electricity supplied through the electrical contact **111**.

Referring now to FIG. **11**, the light emitted from the light emitting elements **802** may cooperate with the prismatic surfaces **332**, **372** and the grooves **318**, **358** to refract the emitted light substantially about the luminaire **100**. The prismatic surfaces, **332**, **372** and the grooves **318**, **358** may be configured to selectively refract light within desired ranges about the luminaire **100**. Furthermore, the light may be refracted to maintain a uniform intensity within desired ranges about the luminaire **100**.

It is understood that the angles referred to herein are measured according to a polar coordinate system, wherein the angles are measured from the positive Z-axis directed vertically. Moreover, the intensities referred to are in reference to an intensity of the light emitted by the luminaire **100** within a certain angle range. In the present embodiment of the invention, the reference intensity is an average intensity of light emitted within the range of angles between 0 degrees and 135 degrees.

Turning now to FIG. **12**, a graph of ranges of light refraction is presented. Light may be refracted within a first range **1210** about the luminaire. The first range **1210** may include angles within a range between about 0 degrees to about 135 degrees. Furthermore, the light emitted within the first range **1210** may be within about 20%, 10%, 5%, or 1% of the average intensity.

Light may also be refracted within a second range **1220** about the luminaire **100**. The second range **1220** may include angles within a range between about 135 to about 150 degrees. Furthermore, the light emitted within the second range **1220** may be within about 20%, 10%, 5%, or 1% of the average intensity. Light may also be refracted within a third range **1230** about the luminaire **100**. The third range **1230** may include angles within a range between about 150 degrees to about 180 degrees. Furthermore, the light emitted within the third range **1230** may be within about 20%, 10%, 5%, or 1% of the average intensity.

Referring now to FIG. **13**, an alternative embodiment of the invention is presented. In FIG. **13**, a luminaire **1300** is presented having similar elements to that of the embodiments described hereinabove. Specifically, the luminaire **1300** may include a body member **1310**, an optic **1320** carried by the body member **1310** and defining an optical chamber (not shown), and a light source (not shown) carried by the body member **1310** and positioned within the optical chamber. In some embodiments, the optic **1320** may have a first surface (not shown) and a second surface **1322**. Similar to the embodiments described herein above, the first surface may be an inner surface of the optic **1320**. Additionally, the first surface may include a plurality of generally vertical segments and a plurality of generally horizontal segments. Furthermore, the second surface **1322** may be generally smooth, and have a curvature. In some embodiments the curvature may be generally concave. The degree of curvature may be configured to distribute light about the optic **1320** in a desired distribution. Yet further, the optic **1320** may have an upper end, a lower end, and a center. The vertical segments may be generally longer towards each of the upper end and the lower end than toward the center. Additionally, the horizontal segments may be generally longer towards the center than towards the upper and lower ends. The vertical segments and the horizontal segments may similarly be configured to distribute light in a desired distribution.

In some embodiments, the optic **1320** may include an upper optic **1324** and a lower optic **1326**. In such embodiments, each of the upper optic **1324** and the lower optic **1326** may include a first surface and a second surface, similar to the first surface and the second surface **1322** described herein above. Similarly, the first surface of each of the upper optic **1324** in the lower optic **1326** may include a plurality of generally vertical segments and a plurality of generally horizontal segments. Furthermore the second surface of each of the upper optic **1324** and the lower optic **1326** may be generally smooth and comprise a curvature. The curvature of the second surface of each of the upper optic **1324** and the lower optic **1326** may be generally concave. More specifically, the curvature of each of the upper optic **1324** in the lower optic **1326** maybe concave in the direction of a center of the optic **1320**, where the upper optic **1324** and the lower optic **1326** are adjacent each other. Additionally, the curvature may be within the range from about X degrees to about Y degrees.

The remaining elements of the luminaire **1300**, including the body number **1310** and the light source, may be substantially as described in the previous embodiments hereinabove.

Some of the illustrative aspects of the present invention may be advantageous in solving the problems herein described and other problems not discussed which are discoverable by a skilled artisan.

While the above description contains much specificity, these should not be construed as limitations on the scope of any embodiment, but as exemplifications of the presented embodiments thereof. Many other ramifications and variations are possible within the teachings of the various embodiments. While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best or only mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, and not by the examples given.

What is claimed is:

1. A luminaire comprising:

a body member;

an optic carried by the body member and defining an optical chamber; the optic chamber comprising an upper optic and a lower optic, each of the upper optic and the lower optic comprising an inner surface and an outer surface; and

a light source carried by the body member and positioned within the optical chamber;

wherein the inner surface of each of the upper optic and the lower optic comprises a plurality of generally vertical segments and a plurality of generally horizontal segments; and

wherein the outer surface of each of the upper optic and the lower optic comprises a generally concave curvature.

2. The luminaire of claim **1** wherein the optic has an upper end, a lower end, and a center; and wherein the generally horizontal segments toward the center are generally longer than the generally horizontal segments toward either of the upper end and the lower end.

3. The luminaire of claim **1** wherein the light source comprises a platform and a plurality of light emitting diodes (LEDs); wherein the plurality of LEDs are distributed about the platform; and wherein the platform is positioned at approximately a center of the optical chamber.

4. The luminaire of claim **3** wherein the platform comprises an upper surface and a lower surface; and wherein the plurality of LEDs are distributed generally about at least one of the upper surface and the lower surface.

5. The luminaire of claim **1** further comprising a reflective surface positioned generally along a longitudinal axis of the luminaire within the optical chamber; wherein the reflective surface is configured to reflect light incident thereupon generally toward the optic.

6. The luminaire of claim **5** wherein the light source comprises a plurality of LEDs; and wherein the plurality of LEDs are positioned generally surrounding the reflective surface.

7. The luminaire of claim **6** wherein the reflective surface is approximately cylindrical; and wherein the plurality of LEDs are positioned in a generally annular configuration.

8. The luminaire of claim **1** wherein the body member comprises an upper structure and a lower structure; and wherein at least one of the upper structure and the lower structure are configured to function as a heat sink.

9. The luminaire of claim **1** wherein each of the upper optic and the lower optic has an upper end and a lower end; wherein the generally horizontal segments toward the lower end of the upper optic and the lower end of the upper optic are generally longer than the generally horizontal segments toward the upper end of the upper optic and the lower end of the lower optic.

10. A luminaire comprising:

an upper structure;

a lower structure;

an optic carried by at least one of the upper structure and the lower structure and defining an optical chamber, the optic comprising an upper optic and a lower optic;

a light source carried by at least one of the upper structure and the lower structure and positioned within the optical chamber, the light source comprising a platform and a plurality of LEDs distributed generally about the platform;

a reflective surface positioned within the optical chamber and configured to reflect light incident thereupon in the direction of the optic;

wherein each of the upper optic and the lower optic comprise an inner surface and an outer surface;

wherein the inner surface of each of the upper optic and the lower optic comprises a plurality of generally vertical segments and a plurality of generally horizontal segments; and

wherein the outer surface of each of the upper optic and the lower optic comprises a generally concave curvature.

11. The luminaire of claim **10** wherein the platform comprises an upper surface and a lower surface; and wherein the plurality of LEDs are distributed generally about each of the upper surface and the lower surface.

12. The luminaire of claim **10** wherein the reflective surface is positioned generally along a longitudinal axis of the luminaire within the optical chamber; wherein the reflective surface is configured to reflect light incident thereupon generally toward the optic.

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